



**Proposed Plan for the West Waterway Operable Unit
Harbor Island Superfund Site
Seattle, Washington
November 1999**

EPA ANNOUNCES PROPOSED PLAN

This Proposed Plan describes the proposed determination by the U.S. Environmental Protection Agency (EPA) that no action is necessary for the marine sediments in the West Waterway of the Duwamish River estuary, which is known as the West Waterway Operable Unit of the Harbor Island Superfund Site, Seattle, WA (Figures 1 and 2). EPA believes that a no action decision is appropriate because environmental investigations and site-specific risk assessments found that concentrations of chemicals (including PCBs, tributyltin, and mercury) in marine sediments within the West Waterway Operable Unit do not pose unacceptable risks to human health and the environment. Further, environmental investigations did not identify any "hot spots" of contaminated sediments that warranted cleanup. EPA believes that sediments with the highest concentrations of chemicals on the western side of Harbor Island are already being cleaned up under EPA's Record of Decision for the "Shipyard Sediment" (Todd and Lockheed Shipyards). Finally, EPA believes that the majority of the contamination associated with the Harbor Island Site, including contamination that could have contributed to sediment problems in the West Waterway Operable Unit, is being addressed as part of the Shipyard Sediment cleanups, upland soil and groundwater cleanups, and upland source cleanups implemented to reduce contaminant inputs into the marine environment. Future work remains to address sediments in the East Waterway adjacent to Harbor Island.

EPA would like your comments on the information discussed in this plan. EPA, with input from the Washington Department of Ecology (Ecology), will make a final determination **only** after all public comments are reviewed and considered. The Muckleshoot Tribe of Indians has expressed concerns regarding EPA's proposed "no action" decision for the marine sediments in the West Waterway Operable Unit. The Muckleshoot Tribe has federally-guaranteed treaty rights to fish in its usual and accustomed fishing area, which includes the Duwamish River, and has stated that the Duwamish River system, including the West Waterway, is very important to the Tribe for commercial and subsistence fishing. The Tribe is concerned that EPA's proposed decision may not be adequately protective of the Tribe's treaty resources and tribal members' health.

The Harbor Island Superfund Site is divided into an upland portion and a marine sediment portion. The upland portion of the Site is addressed by a 1993 Record of Decision for the Soil and Groundwater Operable Unit, and a 1994 Record of Decision for the upland Lockheed Shipyard Operable Unit. Additionally, the petroleum tank farms located at the upland site are being addressed by State of Washington cleanup regulations. The marine sediment portion of the Site is divided into three areas: the Shipyard Sediment Operable Unit (Figure 2), the West Waterway Operable Unit (Figure 2), and the East Waterway Operable Unit. The Shipyard Sediment Operable Unit is addressed by a 1996 Record of Decision, and includes marine sediments adjacent to the Todd Shipyard and the former Lockheed Martin Shipyard. The West Waterway Operable Unit is addressed by this Proposed Plan, and includes approximately 70 acres of marine sediments in the West Waterway. The East Waterway Operable Unit will be addressed at a future time.

The sediment investigation of the West Waterway Operable Unit of the Harbor Island Superfund Site is being conducted by EPA, with a portion of the work being conducted under a legal agreement between EPA and the Port of Seattle, Todd Shipyards, and Lockheed Martin Corporation.

This Proposed Plan is being issued as part of the public participation responsibilities under Section 117(a) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980. This Proposed Plan summarizes information that can be found in greater detail in documents contained in the Information Repository at EPA in Seattle. Additionally, an Administrative Record, a formal collection of the Remedial Investigation/Feasibility Study and other documents EPA relies on when making cleanup decisions, is also available for review at EPA. The public is encouraged to review these documents to gain a more comprehensive understanding of the site and the activities that have been conducted to date.

Information Repository

EPA Records Center

1200 Sixth Avenue, 7th Floor
Seattle, WA 98101

Call 206-553-4494 to arrange a time to look at the documents.

How You Can Participate

You are encouraged to participate in the decision-making process by commenting on the Proposed Plan. EPA will accept written comments on this Proposed Plan during the public comment period from November 15, 1999 to December 14, 1999. Written comments should be addressed to:

Karen Keeley
U.S. Environmental Protection Agency
Region 10, ECL-111
1200 Sixth Avenue
Seattle, WA 98101

If there is sufficient interest in the community, EPA will hold a public meeting to talk about questions and concerns. All public comments will be considered by EPA prior to reaching a final decision. EPA may modify the determination presented in this Proposed Plan based on public comments or on new information.

EPA will respond to public comments in a document called a Responsiveness Summary, which is attached to a final Record of Decision. The Record of Decision and Responsiveness Summary will be available for review at the Information Repository.

SITE LOCATION AND HISTORY

In 1983, Harbor Island was identified as a Superfund site by EPA. Harbor Island is located about 1 mile southwest of downtown Seattle, in King County, Washington. The island lies on the southern edge of Elliott Bay, along the eastern shoreline of Puget Sound (see Figure 1). The Site was listed on the National Priorities List (NPL) due to the release of lead from a secondary lead smelter and the release of other hazardous substances from other industrial operations on the island. Preliminary investigations revealed contamination of soil on Harbor Island and of sediments adjacent to Harbor Island. Suspected sources of chemicals found in sediments included historical disposal practices, direct discharge of waste, storm drains, and other nonpoint dis.

How are the sediment investigations around Harbor Island linked with EPA's other work in the Duwamish River?

A complete investigation of sediments in the Duwamish River estuary is provided by a combination of EPA's work at the Harbor Island Superfund site and EPA's Site Inspection work in the Duwamish River. The Duwamish River studies are evaluating sediments from the head of navigation (near the turning basin in Tukwila) in the Duwamish River down to the southern end of Harbor Island. The Harbor Island work has evaluated sediments from the southern end of Harbor Island (near Kellogg Island) north to Elliott Bay, including both the West and East Waterways.

Sediments within the West Waterway were studied as part of investigations performed for the "Sediments Operable Unit", which generally consisted of all sediments surrounding Harbor Island. Subsequently, sediments within the West Waterway were studied as part of investigations performed for the "Waterway Sediment Operable Unit", which generally consisted of sediments in both the West and East Waterways. To more efficiently complete the sediment investigations, EPA has designated the sediments being studied in the West Waterway as the West Waterway Operable Unit and the sediments being studied in the East Waterway as the East Waterway Operable Unit.

The West Waterway Operable Unit (West Waterway OU) includes approximately 70 acres of marine sediments and is located in the West Waterway at the mouth of the Duwamish River estuary near Harbor Island (Figure 2). The West Waterway is a dredged navigable channel used extensively for industrial purposes. The waterway consists primarily of subtidal sediments, which remain under water even at low tides. The shoreline of the West Waterway is predominantly pilings, bulkhead, and riprap. Areas of intertidal sediments along the shorelines adjacent to the West Waterway OU are generally nonexistent. As shown on Figure 2, the West Waterway OU does not include: 1) sediments associated with the Shipyard Sediment Operable Unit; 2) sediments in portions of the waterway that have recently been dredged (i.e., near Terminal 5); and, 3) sediments in the north-west portion of the waterway that are associated with the Washington Department of Ecology's Lockheed Aquatic Area Site.

EPA completed the Remedial Investigation/Feasibility Study (RI/FS) for all Harbor Island sediments in 1995. The RI/FS primarily focused on identifying physical and ecological characteristics of the area, and evaluating the nature and extent of sediment contamination. Subsequent to EPA's RI/FS, two supplemental remedial investigations were performed, with EPA oversight, in accordance with legal agreements between EPA and various Potentially Responsible Parties. Additionally, an environmental study associated with the ARCO facility was completed within the West Waterway OU in support of non-Superfund related activities. These environmental investigations and studies form the basis for EPA's proposed decision about sediments in the West Waterway OU.

Table 1.
Completed and ongoing cleanup actions at the Harbor Island Superfund Site.

Soil/Groundwater (1993 EPA Record of Decision)

- Excavation and offsite disposal of PCB-contaminated soils (Seattle Iron and Metals) and other "hot spots" of contaminated soils.
- Excavation and onsite treatment of "hot spots" of petroleum-contaminated soils at Todd Shipyards (ongoing).
- Removal and treatment of floating petroleum product and contaminated groundwater at Todd Shipyards (ongoing).
- Capping of exposed soils exceeding cleanup goals (ongoing).

Upland Lockheed Shipyard (1994 EPA Record of Decision)

- Excavation of "hot spots" of petroleum-contaminated soils; capping of soil; and long-term monitoring of groundwater. Deleted from Superfund list in 1996.

Other Source Control (in accordance with Superfund authorities)

- Removal of all sediments in Harbor Island storm drain system; identification and correction of illegal connections (completed 1990).
- Value Metal Plating cleanup (completed 1992).

Petroleum Tank Farms (in accordance with State of Washington cleanup authorities)

- Under a Memorandum of Agreement between EPA and Ecology, EPA designated Ecology the lead agency for the tank farms because petroleum is the primary contaminant of concern. Petroleum is excluded from Superfund regulations, but is regulated as a hazardous substance under the State of Washington Model Toxics Control Act.
- Tank farms include: Equilon (formerly Texaco); ARCO; and GATX (formerly Shell Oil).
- For Equilon, Ecology completed a cleanup action plan and consent decree in April 1999. The cleanup plan includes soil excavation, groundwater cleanup, installation of a hanging wall near the shoreline to act as a barrier to preclude direct groundwater flow to the surface water, and long-term monitoring.
- For GATX, a draft cleanup action plan and draft consent decree are available for public comment until December 2, 1999. The cleanup plan includes groundwater cleanup, soil excavation, soil vapor extraction, soil flushing, soil capping or solidification, natural attenuation, and long-term monitoring. GATX is not located near the shoreline.
- For ARCO, a draft final cleanup action plan and consent decree are available for public comment until December 16, 1999. The cleanup plan includes soil excavation, soil treatment, groundwater cleanup, installation of a hanging wall near the shoreline to act as a barrier to preclude direct groundwater flow to surface water, and long-term monitoring.

Shipyard Sediment (1996 EPA Record of Decision)

- Todd and Lockheed Shipyards. Remedial design activities are underway. Dredging/capping of sediments will be completed.

SUMMARY OF SITE CHARACTERISTICS

Since 1985, numerous environmental investigations have been completed to identify potential adverse human health and ecological effects associated with marine sediments at the Harbor Island Superfund Site, including sediments in the West Waterway OU. Results from these environmental studies were used to define the nature and extent of sediment contamination at the site, and to evaluate potential risks to humans and the environment from these sediments. Human health evaluations focused on potential risks associated with contacting sediment or eating seafood from the study area. Ecological evaluations focused on the effects of sediment contaminants on marine animals. These ecological evaluations consisted of sediment chemical analyses, sediment toxicity testing, and bioaccumulation testing. Sediment toxicity and bioaccumulation testing were performed in a laboratory by exposing marine animals to sediment from the study area.

Extensive investigations and numerous cleanup actions have also been completed for the uplands portion of the Harbor Island site. A summary of completed and ongoing cleanup actions are shown in Table 1. As part of these upland investigations, EPA evaluated the potential for releases of contaminants from the uplands portion of the Harbor Island Site to adjacent sediments, including sediments in the West Waterway OU. EPA believes that all actions necessary to control contaminant releases from the uplands portion of the site to adjacent sediments in the West Waterway OU have been completed or will be addressed through ongoing actions.

During the sediments RI/FS and supplemental investigations, the sediments were analyzed for many groups of possible contaminants, including metals, tributyltin, volatile organic compounds, semivolatile organic compounds, pesticides, and conventional parameters. Data collected during the initial RI indicated that there were certain chemicals that were more frequently detected in sediments around Harbor Island at concentrations exceeding chemical criteria that are set to protect bottom-dwelling animals (see "Cleanup Criteria"). Overall, for Harbor Island sediments, the chemicals that most often exceeded individual chemical criteria were arsenic, copper, lead, mercury, zinc, tributyltin, PCBs and polyaromatic hydrocarbons (PAHs). The highest concentrations of chemicals in sediments on the western side of Harbor Island were found in two areas near the Lockheed and Todd Shipyards, and these contaminated sediments are addressed in EPA's Record of Decision for the Shipyard Sediment Operable Unit. Once the cleanup decision was made for the Shipyard Sediments, it was necessary to re-evaluate the nature and extent of chemical contamination in sediments in the West Waterway OU (see next section).

Cleanup Criteria

The State of Washington Sediment Management Standards (SMS) are used to evaluate contaminated sediments. The SMS standards currently contain chemical and biological effects criteria for the protection of marine animals living in the bottom sediments (the "benthic community").

The SMS establish two types of criteria for chemical concentrations and biological effects: 1) the Sediment Quality Standard (SQS), and 2) the Cleanup Screening Level (CSL). The SQS criteria, which are the lower of the two criteria and are established as long-term goals, represent levels below which adverse effects are not expected. Between the SQS criteria and the CSL criteria are levels at which adverse biological effects are expected to be minor. In practice, the CSL criteria represent levels above which associated adverse biological effects trigger the need to evaluate remedial action. The SMS chemical criteria are generally applied to a "station cluster", which would be evaluated by the average of the highest chemical concentrations from a set of three associated stations.

The SQS and CSL chemical criteria are based on numerical concentrations of chemicals. The SQS and CSL biological criteria are based on adverse effects to organisms as measured in biological tests, such as the sediment toxicity bioassays tests. When there are both chemical and biological effects data collected from a site, the SMS give precedence to the biological effects data in determining whether a remedial action is necessary (i.e., the biological effects data "override" the chemical concentration data). Essentially, this means that if sediments exceed chemical CSL criteria but do not exceed biological CSL criteria, then sediment cleanup is not warranted based on this ecological standard.

SUMMARY OF SITE RISKS

As part of the RI/FS and supplemental investigations, EPA conducted risk assessments to evaluate the current and future effects of contaminants on the environment and human health. The ecological and human health risk evaluations are summarized below.

Ecological Risks

The ecological evaluation consisted of an *assessment of sediment toxicity* throughout the waterway and an *assessment of bioaccumulation potential* for PCBs, tributyltin (TBT), and mercury. The *assessment of sediment toxicity* focuses on the direct impact of contaminants on bottom-dwelling organisms (e.g., worms, clams), known as the "benthic community." The *assessment of bioaccumulation potential* focuses on the potential for adverse impacts to organisms due to accumulation of certain chemicals from sediments to tissues of organisms. Both assessments focused on evaluating *surface sediments* (i.e., generally the top 4 inches of bottom sediments) because benthic organisms live only in these surface sediments; benthic organisms do not live in the deeper sediments. Surface sediments were collected from over 70 different stations in the West Waterway. Further details are provided below.

Sediment Toxicity Assessment -- The primary objective of the sediment toxicity assessment was to identify any potential areas that may pose a risk to organisms that live within the surface sediments of the waterway. The sediment toxicity assessment was based primarily on the evaluation of the following types of information collected about individual stations: 1) results of comparisons between concentrations of individual chemicals in surface sediments and the corresponding Washington State sediment chemical cleanup screening level (CSL) criteria; and, 2) results of surface sediment toxicity tests performed in a laboratory by exposing three different marine animal species to sediment from the bottom of West Waterway, and comparison of those results to appropriate Washington State biological CSL criteria (see "Cleanup Criteria" on page 5).

Within the area defined as the West Waterway OU, 33 surface sediment stations were sampled as part of the RI/FS. Although exceedances of state sediment criteria are generally determined based on clusters of three stations (see "Cleanup Criteria"), a more conservative approach was used for this evaluation -- individual chemical concentrations from a single station were directly compared to the corresponding state chemical criteria. Mercury exceeded the Washington State CSL at 11 stations, bis(ethylhexyl)phthalate exceeded the state CSL at 8 stations, benzo(g,h,i)pyrene exceeded the state CSL at 2 stations, and phenol exceeded the state CSL at 2 stations. For the other 44 chemicals measured at each of these 33 stations, the state CSL was not exceeded or was only exceeded at one station -- as noted in the "Cleanup Criteria", a single exceedance of a chemical at a station is not considered a "hot spot" and does not require further evaluation. Tributyltin (for which no state criteria exists) was also identified as a chemical of concern. Sediments at these stations were also analyzed for pesticides and volatile organic compounds (for which no state criteria exist), and these chemicals were not identified as chemicals of concern based on comparison of results to background concentrations, cleanup screening levels used by other regulatory programs, or cleanup criteria selected at other Superfund sites.

After the RI/FS, a second sediment investigation was performed for chemical analyses and sediment toxicity testing. This investigation was performed because the initial RI/FS only analyzed sediments for chemical concentrations, and thus did not adequately define the extent of surface sediments that may potentially warrant cleanup based on consideration of both chemical *and biological* criteria. For this second investigation, 25 surface sediment stations were sampled within the West Waterway OU (some stations were new and some were located in the same position as the initial RI/FS stations; an additional 8 sediment stations were sampled within the West Waterway but outside the West Waterway OU). Within the West Waterway OU, exceedances of CSL chemical criteria were evaluated based on a discrete station-by-station comparison rather than by station clusters. Mercury exceeded the state CSL at 14 stations, and zinc exceeded the state CSL at 2 stations. For the other 45 chemicals measured at these 25 stations, the state CSL was not exceeded or was only exceeded at one station -- as noted in the "Cleanup Criteria", a single exceedance of a chemical at a station is not considered a "hot spot" and does not require further evaluation. The previous CSL exceedances of bis(ethylhexyl)phthalate, benzo(g,h,i)pyrene, and phenol that were found during the initial RI/FS were not found during this investigation. Tributyltin (for which no state criteria exists) was also identified as a chemical of concern. Sediments at these stations were also analyzed for pesticides and volatile organic compounds (for which no state criteria exist), and these chemicals were again not identified as chemicals of concern based on comparison of results to background concentrations, cleanup screening levels used by other regulatory programs, or cleanup criteria selected at other Superfund sites.

As noted above, the second sediment investigation also included sediment toxicity testing. This biological testing was performed at 22 surface stations in the West Waterway, and 18 of those 22 stations were located within the West Waterway OU. Based on results of sediment toxicity tests for

three different species, all of the 22 stations passed the state CSL biological criteria. These results mean that even though some individual stations had chemical concentration(s) that exceeded the state's CSL chemical criteria, the state CSL biological criteria was not exceeded at any station, which indicates that sediment cleanup is not warranted based on these standards.

Assessment of Bioaccumulation Potential -- Although chemicals in sediments were not found to pose a risk to benthic communities, it was recognized that the long-term effects of PCBs, tributyltin, and mercury bioaccumulation were not addressed using the state's Sediment Management Standards. Because of those concerns, EPA required a third sediment and tissue investigation. This investigation included two studies: 1) a tributyltin field and laboratory study, and 2) a literature review of tissue residue effects data for PCBs, tributyltin, and mercury in marine organisms. For informational purposes, ranges of concentrations of PCBs, tributyltin, and mercury found in the sediments in the West Waterway OU are described in the insert on this page.

The tributyltin (TBT) field and laboratory study evaluated ecological impacts associated with exposure to TBT in sediments. TBT is of concern because TBT can affect the growth, reproduction, and survival of marine organisms, particularly snails and clams. Further, it was believed that the need for cleaning up TBT-contaminated sediments would be driven by potential adverse ecological effects due to TBT. The overall purpose of the TBT study was to develop a site-specific tissue concentration for TBT that reflects a concentration above which adverse ecological impacts may occur. The TBT tissue concentration would then be used to evaluate site-specific tissue data to determine the need for remediation of TBT-contaminated sediments in the West Waterway. As part of the study, sediments at 30 stations within the West Waterway OU were collected and analyzed for bulk sediment and porewater concentrations of TBT. Next, sediments from 20 of the most contaminated stations were submitted for bioaccumulation testing. Laboratory bioaccumulation tests were performed using clams and worms exposed to site sediments. The resulting concentrations of TBT in the tissues of both test organisms were measured. All tissue concentrations were below the site-specific TBT tissue trigger value of 3.0 ppm dry weight TBT. Therefore, although TBT was found at elevated concentrations in the sediments, it did not appear to be bioaccumulating to levels of concern in the marine animals. Thus, based on this assessment, TBT in the West Waterway OU was not

Measurements of PCB, tributyltin, and mercury concentrations found in sediments in the West Waterway OU

Total PCB sediment concentrations ranged from undetected to a maximum of 0.467 ppm dry weight (RI/FS study) and 1.46 ppm dry weight (1995 study). The median of total PCB sediment concentrations was 0.085 ppm dry weight (RI/FS study) and 0.311 ppm dry weight (1995 study). These total PCB concentrations were calculated assuming a value of zero for PCB Aroclors qualified as undetected.

Using different units for the same data set, total PCB sediment concentrations ranged from 0.1 ppm-oc to a maximum of 39.6 ppm-oc (RI/FS study) and 87.9 ppm-oc (1995 study). The median of total PCB sediment concentrations was 6.8 ppm-oc (RI/FS study) and 18.3 ppm-oc (1995 study). These total PCB concentrations were calculated using one-half the detection limit for Aroclors qualified as undetected. The unit "oc" refers to carbon normalization of the data values.

For the sediments sampled for PCB analysis in the West Waterway OU, only 1 of 58 stations had a PCB concentration that exceeded the state criterion (CSL criterion = 65 ppm carbon-normalized total PCBs), which is set to protect the benthic community.

Tributyltin sediment concentrations (dry weight) ranged from 253 ppb to 1,988 ppb (maximum, 1995 study) and to 15,255 ppb (maximum, RI/FS study). No state sediment criteria exist for tributyltin.

Mercury sediment concentrations (dry weight) ranged from undetected to 1.42 ppm (maximum, RI/FS study) and to 2.23 ppm (maximum, 1995 study). The state CSL chemical criterion is 0.59 ppm mercury.

found to cause adverse effects on marine animals and cleanup of sediments containing TBT is not necessary to protect the environment.

The 3.0 ppm dry weight TBT tissue trigger value was determined based on results from a literature review of *tissue residue effects data*. This value was considered protective of bivalves (e.g., clams) and gastropods (e.g., snails), but may not protect the most sensitive species of snails (which tend to be very rare in Elliott Bay and the Duwamish River system).

As a second component of the *assessment of bioaccumulation potential*, a literature review of *tissue residue effects data* for PCBs and mercury was completed to determine whether tissue concentrations of PCBs and mercury in fish and shellfish determined to be protective of human health (via the seafood consumption pathway) would also likely be protective of aquatic species. Results of this evaluation found that, based on existing science, lower tissue concentrations of PCBs and mercury in aquatic species are needed to protect human health (via the seafood ingestion pathway) than are needed to protect the health of those aquatic species (i.e., the decision on whether to remediate sediments with PCBs or mercury would be determined based on results of the human health risk assessment, and not the ecological risk assessment).

Other Studies -- An additional sediment study was performed within the West Waterway OU in an area adjacent to the ARCO facility. Results confirmed that chemical concentrations were low in this area, and sediment cleanup was not warranted.

Conclusion -- Chemicals in sediments within the West Waterway OU do not pose a risk to the benthic community that live in the sediments. Further, bioaccumulative chemicals (PCBs, tributyltin, and mercury) in sediments do not appear to negatively effect aquatic invertebrates or fish. Thus, based on these assessments, sediments in the West Waterway OU do not require remediation to address ecological concerns.

Human Health Risks

The RI/FS examined three potential pathways of exposure by humans to contamination in the sediments. These included: 1) consumption of fish and shellfish that may contain chemicals bioaccumulated from sediments; 2) skin contact with sediment; and, 3) incidental ingestion of sediment.

As an initial approach, the RI referenced an evaluation of a human health risk assessment of Puget Sound seafood completed in 1988. This earlier risk assessment evaluated potential *cancer risks* and *non-cancer adverse health effects* associated with regular consumption of recreationally harvested seafood from Puget Sound (see "Definitions of Cancer Risk and Non-Cancer Health Effects"). Based on an analysis of seafood tissue data presented in the 1988 assessment, the RI presented cancer risks and non-cancer health effects associated with consumption of seafood collected from Elliott Bay (a subset of the overall Puget Sound risk assessment). Using the 1988 data, the RI concluded that both the cancer risks and non-cancer health effects associated with consumption of Elliott Bay seafood are equivalent to those reported Puget Sound-wide. The overall conclusion of the Puget Sound study was that lifetime exposure (70 yrs) to the chemicals of concern may result in moderate risk for average consumers, while a higher health risk may exist for heavy consumers. Although the RI presented cancer and non-cancer risks based on these earlier 1988 data, the RI concluded that due to the high mobility of fish and crab and the extent of contamination in Elliott Bay and the Duwamish River, a consumption scenario that isolates risks due to exposure to Harbor Island sediment was not feasible. It was further observed that even though ingestion of seafood exposed to sediments surrounding Harbor Island (including the West Waterway OU) may be the most significant exposure pathway to humans, the uncertainties associated with a source-specific pathway (such as assuming that all chemicals found in seafood tissue came only from sediments around Harbor Island) are too high to make risk estimations meaningful. In summary, the RI presented existing information on human health risk assessments of seafood for Elliott

Definitions of Cancer Risk and Non-Cancer Health Effects

In a human health risk assessment, EPA estimates *cancer risk* for carcinogens and *non-cancer health effects* for non-carcinogens.

For cancer-causing chemicals, risks are generally expressed as *excess cancer risk*. *Excess cancer risk* is defined as the risk of cancer over a lifetime that is in excess of the risk from all other sources besides fish and shellfish ingested from the study area. An excess cancer risk of 1×10^{-4} indicates that an individual experiencing the *reasonable maximum exposure* has an estimated 1 in 10,000 chance of developing cancer as a result of site-related exposure. In other words, for every 10,000 people that could be exposed, one extra cancer may occur as a result of exposure to site contaminants. This is referred to as an "excess lifetime cancer risk" because it would be in addition to the risks of cancer individuals face from other causes such as smoking or exposure to too much sun. The chance of an individual's developing cancer from all other causes has been estimated to be as high as 1 in 3. As defined in the National Contingency Plan, the framework regulation for the Superfund program, EPA's generally acceptable risk range for site-related exposure is 1 in 10,000 to 1 in 1,000,000 (i.e., 10^{-4} to 10^{-6} or $1\text{E-}4$ to $1\text{E-}6$), which represents EPA's opinion on what are generally acceptable levels. For sites where the cumulative risk to an individual based on the *reasonable maximum exposure* for both current and future land use is less than 10^{-4} , action generally is not warranted unless there are unacceptable non-cancer health effects or adverse ecological impacts.

For *non-cancer health effects*, the potential for non-cancer toxicity to occur to an individual is evaluated by using a ratio of "exposure" to "toxicity"; it is not expressed as the probability of an individual suffering an adverse effect. The ratio of exposure to toxicity is called a Hazard Quotient (HQ), and the sum, as appropriate, of all HQs is called a Hazard Index (HI). An HQ less than 1 indicates that toxic non-cancer effects are unlikely to result from exposure to that chemical at the site. Similarly, an hazard index (HI) less than 1 indicates that, based on the sum of all HQs from different contaminants and exposure routes, toxic non-cancer effects are unlikely to result from exposure to all chemicals at the site. As defined in the National Contingency Plan, acceptable exposure levels for non-carcinogens should represent levels to which the human population, including sensitive subpopulations, may be exposed without adverse effect during a lifetime. In contrast to the numerical target risk range described for carcinogens, a numerical target value is not described in the National Contingency Plan.

Bay and Puget Sound, but the RI concluded that it was inappropriate to perform a site-specific risk assessment for this exposure pathway at the Harbor Island Superfund Site.

Although a seafood ingestion pathway was not evaluated, the RI evaluated potential human health risks to tribal fishers that may be exposed to contaminated marine sediments while net fishing within the general area of the Harbor Island Superfund Site. To estimate potential risk due to contact (ingestion and dermal exposure under a Reasonable Maximum Exposure scenario) with sediment by tribal net fishers, the general area of the site was divided into four study areas: Kellogg Island, East Waterway, West Waterway, and North Harbor Island. Results indicate that potential excess cancer risk from dermal exposure to sediments is less than 1 in 100,000, which does not warrant regulatory action. Further, all total hazard indices are below 1.0, indicating that non-cancer health effects are not expected from contaminant exposure at the site.

At the request of the Muckleshoot Tribe, EPA re-evaluated the RI human health risk assessment with respect to tribal net fishers that may be exposed to contaminated marine sediments while net fishing within the general area of the Site. Based on results of this re-evaluation, EPA confirmed that sediments in West Waterway do not trigger cleanup action under Superfund based on estimated risks to tribal fishers that may be exposed to sediments while net fishing.

In 1999, an additional human health risk assessment was completed to evaluate risks associated with three bioaccumulative compounds -- PCBs, tributyltin, and mercury -- that may potentially bioaccumulate from site sediments to fish and shellfish that live in the West Waterway and are eaten by people. For this assessment, seafood was collected from the West Waterway, and the concentrations of PCBs, tributyltin, and mercury in the animals' tissue were measured. The purpose of this "baseline risk assessment" is to estimate the likelihood of health problems occurring under existing conditions.

Cancer risks for PCBs and non-cancer health effects for PCBs, tributyltin, and mercury were estimated for two scenarios: 1) a *reasonable maximum exposure* scenario for tribal fishers, which is intended to represent the highest level of human exposure that could reasonably be expected to occur; and 2) an *average* scenario for recreational fishers, which is intended to represent exposure for other consumers. For both scenarios, it was assumed that an individual fisher obtained all the seafood in their diet from the West Waterway OU for 30 years (for the tribal fisher) or for 9 years (for the recreational fisher). The exposure parameters are reasonable and protective of the potentially exposed populations.

For the West Waterway, the types of seafood that are most likely to be consumed can be divided into four different categories: anadromous fish (e.g., salmon); fish that generally feed in the water column (e.g., herring, perch); fish that generally feed off the bottom (e.g., sole, flounder); and shellfish (e.g., clams, squid, crab). However, it is infeasible to measure chemical concentrations in every fish and shellfish species that could be consumed; therefore, salmon, perch, English sole, and crab were used as surrogates to represent the four different categories, respectively. For the baseline risk assessment, consumption of salmon was excluded because bioaccumulation of contaminants in salmon is primarily attributable to dietary sources outside the Superfund site.

Results of the risk assessment were presented in the form of *excess cancer risk* for PCBs, and potential adverse *non-cancer health effects* for PCBs, tributyltin, and mercury (see "Definitions of Cancer Risk and Non-Cancer Health Effects" on page 9).

For the baseline risk assessment *reasonable maximum exposure* scenario, excess cancer risk for PCBs was 1 in 10,000 (1×10^{-4}) for the West Waterway OU. This level of acceptable risk is consistent

with EPA's acceptable risk range of 1 in 10,000 to 1 in 1,000,000 (i.e., 10^{-4} to 10^{-6}). The non-cancer health effects estimated for PCBs was $HQ = 6.5$, which is within the range of uncertainty of the PCB toxicity criterion, and thus, adverse health effects are unlikely to result from exposure to PCBs at the site. The non-cancer health effects for summed PCB and tributyltin HQs was $HI = 6.5$ -- this value is the same as the PCB $HQ = 6.5$, and as described above, adverse health effects are unlikely to result from site exposure to both PCBs and tributyltin. HQ estimates for mercury and tributyltin were below 1, so non-cancer effects are not expected from exposures to mercury and tributyltin at this site.

As a separate part of the 1999 human health risk assessment, an additional evaluation was completed to estimate human health risks associated with consuming seafood from other sections of waterbodies that are located near the West Waterway. The other sections of waterbodies that were studied included an adjacent waterway (East Waterway) and areas upstream (Lower Duwamish River, Upper Duwamish River) and downstream (Elliott Bay) of the site. Results showed that the total excess cancer risks estimated for seafood consumed from the West Waterway were similar to the other sections of waterbodies, which indicates that PCB concentrations in seafood are similar throughout the system.

EPA believes that the baseline human health risk assessment incorporates several conservative assumptions. First, the risk assessment included the conservative assumption that all non-salmon fish and shellfish consumed by the target population (a tribal fisher) from Puget Sound for a 30 year period are from the West Waterway OU (i.e., it was assumed that all seafood consumed, except for seafood from restaurants and grocery stores, was caught only from the West Waterway OU and not from any other area). EPA believes that this assumption is extremely unlikely. Given the small size of the West Waterway OU (approximately 70 acres), the absence of intertidal habitat within the West Waterway OU, and the availability of more suitable habitat for resident fish and shellfish outside the West Waterway, the "true" amount of seafood caught and consumed from the West Waterway OU is likely to be much lower (which would result in less risk).

Second, this specific risk assessment included the conservative assumption that all non-salmon seafood consumed from the West Waterway OU contained chemical concentrations that were equal to the maximum chemical concentration that was measured for the species tested.

Third, as standard practice, the risk assessment is based on a numerical value called a "slope factor" to assess carcinogenic risks associated with PCBs. Use of this factor results in a risk estimate that is generally an *upper-bound estimate*. This means that EPA is reasonably confident that the "true risk" will not exceed the risk estimate derived through the assessment, and is likely to be *less* than that predicted.

As described above, the results of the human health risk assessment are intended to be used to identify whether sediments are contaminated and should be cleaned up. In light of that purpose, one of the difficulties in interpreting the results of this type of exposure pathway (i.e., eating seafood) is that we do not really know from where the animals accumulated the chemicals. For example, were the PCBs found in the perch or crab tissue accumulated from PCBs in West Waterway sediments, or were they accumulated from other locations (e.g., Duwamish River) and other sources (e.g., fish or crab prey that may range throughout the system)? Although no site-specific studies of species home ranges have been conducted, it is recognized that the bottom sediments included in the West Waterway OU are likely to be only a small part of the overall home range of fish and shellfish (e.g., crab) species routinely consumed by area fishers. Thus, given the types of PCB sediment concentrations found in the West Waterway OU, it is somewhat difficult to link seafood tissue chemical concentrations with sediment chemical concentrations for such a small area of the overall system. It is recognized that a different approach or determination may be appropriate for small areas of high concentrations of chemicals (e.g., hot spots) in sediments.

Conclusion -- A human health risk assessment was conducted to identify potential risks posed by chemicals detected in sediments or seafood (e.g., fish, shellfish) from the West Waterway OU. Based on these assessments, the cumulative site risk to an individual based on reasonable maximum exposure for both current and future use is 1×10^{-4} , and the *true* risk is likely to be less than 1×10^{-4} . Further, although the hazard index is slightly greater than 1, non-cancer health effects are unlikely to result from site exposure. Given that the estimated excess cancer risk is within EPA's target risk range, and considering site-specific conditions and the conservative nature of the human health risk assessment, EPA believes that the sediments in the West Waterway OU do not pose unacceptable risks to human health and sediment cleanup is not warranted.

SUMMARY

For the West Waterway OU, the RI/FS and supplemental investigations demonstrate that concentrations of chemicals (including the three bioaccumulative chemicals of concern, PCBs, tributyltin, and mercury) in marine sediments do not pose unacceptable risks to human health or the environment. This conclusion is based on a comparison of site data to the Washington State Sediment Management Standards, results of site-specific human health and ecological risk assessments, and results of site-specific work on tributyltin toxicity and bioaccumulation. Chemical contaminants were not found to cause toxicity to animals living in or on bottom sediments, and estimates of human health risks were within EPA's acceptable risk range. Additionally, no "hot spots" of chemical contamination were found in the sediments.

EPA believes that the highest concentrations of chemicals in sediments on the western side of Harbor Island are already being cleaned up under EPA's Record of Decision for the Todd and Lockheed Shipyard sediments. EPA also believes that the majority of the contamination associated with the Harbor Island Site is being addressed as part of these shipyard sediment cleanups, the upland soil and groundwater cleanups, and the upland source cleanups implemented to reduce contaminant inputs into the marine environment.

In summary, EPA believes that a no action decision is appropriate for the West Waterway Operable Unit of the Harbor Island Superfund site because the marine sediments do not pose unacceptable risks to human health and the environment.

EPA would like your comments on the information discussed in this plan. EPA, with input from the Washington Department of Ecology, will make a final determination only after all public comments are reviewed and considered. Even after documenting its final decision in a Record of Decision, EPA has the ability to revise its decision based on new information that shows that action is necessary to protect human health or the environment.

DEFINITIONS

Benthic community - Animals (e.g., worms, clams) living in the bottom sediments of a water body.

Bioaccumulative chemicals - Chemicals that can build up in tissues of animals and can be passed to other organisms through the food chain.

Mercury - Mercury is in the environment due to both natural and man-made processes. For this study, "total" mercury was analyzed in sediment and tissue samples. Although total mercury was measured, the toxicity values for "methlymercury" were used to evaluate those concentrations. Methylmercury is the most toxic species of mercury.

PCBs - Polychlorinated biphenyls, know as "PCBs", are an organic chemical. There were 7 commercial mixtures of PCBs that were manufactured and marketed under the trade name "Aroclor." PCBs were commonly used in electric transformers as insulators and coolants, in lubricants, adhesives, and caulking compounds. For each unique sample in this study, total PCBs were determined by adding up the measured concentrations of each of the 7 different Aroclor concentrations.

Protection of human health and the environment - Protection of people and animals (including bottom-dwelling animals in sediments) from short-term and long-term risks by eliminating, reducing or controlling exposure to hazardous or toxic substances, pollutants or contaminants released into air, land or water.

Record of Decision - A document signed by EPA outlining the selected remedy for a Superfund site. The Record of Decision includes a responsiveness summary, which responds to comments raised during the public comment period for the Proposed Plan.

Risk Assessment - A study conducted as part of the Remedial Investigation to determine the threats posed to human health and the environment if the site's contamination is left unaddressed. The study takes into account such factors as the contaminant's toxicity and the paths and likelihoods of exposure.

Sediments - Materials on the bottoms of rivers, bays, and other waterbodies. Sediments consist primarily of clay, silt, sand, and gravel along with some organic material from decomposing plants and animals.

Sediment quality values - In general, values are chemical concentrations in sediments and sediment toxicity test endpoints that are considered protective of benthic communities in sediments.

Sediment toxicity - Sediments that may pose a risk to animals that live in the sediments.

Station - A discrete location in the West Waterway where sediments were collected for chemical and biological analysis.

Tissue residue effects data - Refers to data where there was a *measured* chemical concentration in the whole body or tissue of an animal, and there was some observation of a biological *effect* in the animal (e.g., survival, growth, or reproduction was affected).